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WATER RESOURCES STUDY BAYOU BARTHOLOMEW BASIN ARKANSAS AND LOUISIANA. STUDY OF EFFECTS OF PROPOSED FLOODWATER RETARDING RESERVOIRS AND CHANNEL IMPROVEMENTS ON WATER QUALITY

Public Health Service
Dallas, Texas

August 1964

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WATER RESOURCES STUDY
BAYOU BARTHOLOMEW BASIN
ARKANSAS AND LOUISIANA

Study of Effects of Proposed Floodwater Retarding Reservoirs and Channel Improvements on Water Quality

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service, Region VII
Dallas, Texas
AUGUST 1964

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PB 230 016

WATER RESOURCES STUDY

BAYOU BARTHOLOMEW BASIN

ARKANSAS AND LOUISIANA

Prepared for

DEPARTMENT OF THE ARMY

U.S. Army Engineer District

Vicksburg, Mississippi

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service, Region VII
Dallas, Texas

AUGUST 1964

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I. INTRODUCTION

Authority

The Corps of Engineers, Vicksburg District, in a letter dated November 1, 1963, requested the assistance of the Public Health Service in developing data with respect to the effects of proposed channel improvements on water quality in Bayou Bartholomew.

Purpose and Scope

This report presents information and data pertaining to an investigation of water quality problems which might arise in Bayou Bartholomew in the vicinity of Bastrop, Louisiana, resulting from proposed flood control plans.

The investigation was specifically concerned with the following:

1. "Probable increase in turbidity that would result from the channel improvement plan in the report.

2. Change in chemical composition of water at the latitude of Bastrop, Louisiana, as a result of the channel improvement plan.

3. Approximate cost of necessary facilities to eliminate or reduce turbidity and/or chemical contaminant resulting from the improvements, assuming water requirements as shown in material furnished.

4. Estimates of persistence of turbidity and/or chemical contaminant once the channel improvement has been constructed." 1/

Limitations of time and availability of data pertinent to the effects on water quality of flood control works of the type proposed restricted the study.

Acknowledgments

Acknowledgment is gratefully made of the cooperation and assistance of the following:

Louisiana State Agencies

Department of Public Works
Stream Control Commission
Division of Public Health Engineering - State Board of Health

Federal Agencies

U.S. Department of the Army
U.S. Geological Survey

Local Officials

International Paper Company
Delhi, Louisiana Water Works

II. SUMMARY AND CONCLUSIONS

Summary

1. The Corps of Engineers proposes:

   a. A system of 25 reservoirs along the west escarpment of the Bayou Bartholomew basin.

   b. Closure of high-water outlets between the Bayou Bartholomew and the Boeuf and Tensas Rivers and Bayou Macon basins.

   c. A system of six local levees in the Louisiana portion of the basin.

   According to the Corps of Engineers, a comprehensive plan including channel-improvement in addition to these three improvements would provide the highest degree of flood protection for the Bayou Bartholomew basin that is economically justified at this time. The channel modifications were considered but not recommended for authorization by the Corps of Engineers.

2. The runoff characteristics of Bayou Bartholomew basin are similar to those of Bayou LaFourche and Bayou Macon, which it, in general, parallels. All three stream systems have headwaters in that area of southeastern Arkansas southeast of Pine Bluff (Arkansas), west of the Mississippi River, and are tributary to the Ouachita River.

3. The quality of Bayou Bartholomew is excellent with respect to chlorides, sulfates, hardness, and dissolved solids, as well as other parameters, but contains a relatively high concentration of color. However, the color present can be reduced to an acceptable level by treatment. The quality and quantity of surface waters in the lower Bayou Bartholomew basin are affected by the quality and quantity of water in the alluvial aquifer, as ground water from this aquifer provides a major portion of the stream's base flow under drought conditions.

4. Ground water obtained from the alluvial sands (100 feet) of Bayou Bartholomew in the Bastrop area is of excellent chemical quality.

5. International Paper Company is the largest water user in the Bayou Bartholomew basin. Total current water use of the two paper mills at Bastrop is approximately 47.5 million gallons daily (mgd) of which 26 mgd is obtained from Bayou

Bartholomew and the remainder from ground water.

6. One of the mills at Bastrop produces a high quality paper requiring extremely high quality water for its manufacture.

Conclusions

1. The flood control plan proposed by the Corps of Engineers, consisting of numerous small floodwater-retarding reservoirs, levees, and high water closures, should not significantly affect turbidity of Bayou Bartholomew in the vicinity of Bastrop, Louisiana. Neither should these works affect chemical quality of Bayou Bartholomew significantly.

2. The channel modifications (channel clearing, cleanout, and enlargement) proposed in the comprehensive plan will increase turbidity during the time the channel work is being carried out.

3. The proposed flood control works should not alter the chemical characteristics of Bayou Bartholomew. However, while no change is expected, the possibility that chemical quality might be affected by clearing and snagging the channel (as discussed in the comprehensive plan) should not be overlooked.

4. Indications are that, in Bayou Bartholomew:

   a. Chemical quality of the stream is affected more by the amount of runoff than any other natural factor.

   b. The channel improvements proposed in the comprehensive plan will appreciably alter the time but not the amount of runoff.

5. Based upon the effects of channel alterations in Bayou LaFourche, the availability of water supply from Bayou Bartholomew will be decreased by the channel works proposed in the comprehensive plan. (Since no water quality data is available for Bayou LaFourche, evaluation of the water quality aspects is not possible.)

6. Channel improvements, as proposed in the comprehensive plan, will produce a long-term effect on the physical quality of the stream by providing greater stream velocities resulting in increased carrying capacity for turbidity. This condition will exist as long as the improvement is effective.

7. Increased turbidity in the amounts anticipated as the result of the comprehensive plan channel modification should not increase water treatment costs significantly but will reduce the life of raw water storage reservoirs. Insufficient data are available to evaluate this aspect properly.

8. Increased turbidity in the modified channel in the comprehensive plan would degrade the stream habitat for fish and other aquatic life as well as the esthetics of the stream. The effect would be intangible but should be considered in evaluation of the proposed improvements.

III. DESCRIPTION OF PROJECT

General

Bayou Bartholomew, as shown on Figure III-1 (at the back of this report), is one of the principal east-bank tributaries of the Ouachita River. The Corps of Engineers has proposed construction of various works to alleviate the flood problem in the Bayou Bartholomew basin.

In this basin, flooding largely results from quick runoff from the hill section of the watershed, and from the deteriorated condition of the stream's channel. During periods of high flow, floodwaters originating in this basin, in addition to flooding the adjacent bottomlands along Bayou Bartholomew, cross the divide on the east and enter channels of the adjoining rivers. This adds to the flood problems of these streams. Studies by the Corps of Engineers of available records indicate that significant diversion occurs about one in seven years. 2/

Proposed Plans

Combinations of three types of flood control works were considered by the Corps of Engineers consisting of:

1. Reservoirs,
2. Channel modifications,
3. Levees and high water closures.

Two plans were investigated by the Corps of Engineers. The first, consisting of 25 small floodwater retarding reservoirs, levees, and high water closures only, is recommended by the Corps of Engineers. The other, a comprehensive basin plan, includes extensive channel modification in addition to the flood control works proposed in the recommended plan.

Proposed Flood-Retarding Reservoirs

The 25 proposed flood-retarding reservoirs will be located on tributary streams along the west escarpment in the upper two-thirds of the Bayou Bartholomew basin. These reservoirs will range in storage capacity from 1,176 acre-feet to 53,896 acre-feet, and will control from 25 to 123.3 square miles each.

The combined total storage capacity of all 25 reservoirs will be 219,377 acre-feet, controlling 500.8 square miles of drainage area. In addition to the proposed Corps of Engineers structures,

Soil Conservation Service plans will control 95 square miles of drainage by providing a total of 42,264 acre-feet of storage in flood-retarding reservoirs. 2/

Proposed Levees and High Water Outlet Closures

This portion of the proposed flood-protection plan includes protection of localized areas in the lower part of the basin by means of loop levees and 20 high water outlets along the banks of Bayou Bartholomew through which floodwaters escape into the Boeuf and Tensas Rivers and Bayou Macon basins to the east. The levees will be located in six lower basin areas, between river miles 16 and 72.8, ranging in length from 6.5 to 20.6 miles and in average height from 3.2 to 12 feet. 2/

Channel Modifications

The proposed comprehensive flood control plan for the Bayou Bartholomew basin consists of an auxiliary channel in the middle basin, with channel cleanout above and snagging below, and a short cutoff in the upper basin. 2/ These channel modifications were considered but not recommended for authorization by the Corps of Engineers.

IV. DESCRIPTION OF THE BASIN

General

Bayou Bartholomew is one of the principal east-bank tributaries of the Ouachita River. Its source is in Jefferson County, Arkansas, approximately 10 miles northwest of Pine Bluff, from which point it flows through a tortuous channel to its junction with the Ouachita River at a point upstream from Monroe, Louisiana. The area of the Bayou Bartholomew watershed is 1,718 square miles, of which 1,074 square miles are upland area and the remaining 644 square miles are flood-plain lands. The length of the valley is approximately 145 miles, whereas the channel length approximates 370 miles.

Topography

The Bayou Bartholomew basin is generally rolling in the hill land and nearly level in the flood plain. There is a well-defined, though relatively low, escarpment on the boundary between the hill land and the flood plain of Bayou Bartholomew, and this escarpment roughly parallels the course of the bayou from 1 to 2 miles to the west in the lower and upper reaches, and 6 to 7 miles to the west in the central portion. Elevations in the hill section range from about 100 feet, mean sea level, in the vicinity of Bastrop, Louisiana, to about 385 feet, mean sea level, in the vicinity of Star City, Arkansas. The alluvial valley portion of the watershed has a slope from north to south of approximately 0.5 foot per mile except in the extreme upper reaches, where the slope approximates 1 foot per mile. The Bayou Bartholomew watershed is separated from the Boeuf and Tensas Rivers and Bayou Macon basins to the east by a low divide which contains numerous depressions.

Climate and Precipitation

The climate of the Bayou Bartholomew drainage area is mild, with long, hot summers, and short, moderate winters. Average monthly temperatures vary from 82° F. during July and August to 45° F. in January, with an average annual temperature of 64° F. Maximum observed temperature was 115° F. on July 29, 1930, and the minimum was -11° F. on February 11, 1899.

Distribution of rainfall is fairly uniform over the watershed, with an average annual amount of 51 inches. The average of minimum readings throughout the basin is 36 inches, with a corresponding maximum of 70 inches. Heavy winter and spring rains are characteristic of the area. Average monthly rainfall varies from 3 inches to 6 inches, with more than 4 inches per month being experienced from November through May. Snowfall in the area is generally light and usually melts in a few days. Average annual snowfall is about 3 inches.

Economy and Population

The fertile soil of the Bayou Bartholomew flood plain is the most valuable resource of the basin, and agriculture on about 37 percent of the area is its principal source of income. However, the production and processing of timber from managed woodlands in the hill section of the basin and, to a lesser extent, in the flood plain is another significant source of income. Oil and gas production in and adjacent to the lower end of the basin and bauxite deposits in the upper part of the basin are other natural resources.

Industries now located in the basin are allied, for the most part, with the processing of agricultural and forest products. Two papermills at Bastrop, Louisiana are the largest single water-using industries within the basin. However, there are numerous smaller wood-using industries, grain elevators, cotton gins, etc., located within the watershed.

The population of the six counties in Arkansas and one parish in Louisiana within which the Bayou Bartholomew basin lies was 215,664 in 1960, of which about 57 percent was rural. Since 1950, the population of the area has decreased 4 percent, and this decrease is comparable to that which other predominantly rural sections of the general area are experiencing. The major city in the lower basin is Bastrop, Louisiana, with a 1960 population of 15,193.

V. WATER RESOURCES

Ground Water

Ground water is a source of municipal and industrial water supply at Bastrop, Louisiana as well as all other municipalities in the basin. Several aquifers yield water in varying amounts. In the Bastrop area, water is available from the Pleistocene Sand (600 feet), and the alluvial sands (100 feet). Typical quality is shown in Table V-1.

Table V-1

Characteristics - Ground Water Sources
Bastrop, Louisiana Area

	Source of Sample	
	Municipal Supply Well	Paper Company Well
pH	9.3	5.4
Dissolved Solids*	724	78
Bicarbonates (as $CaCO_3$)*	--	20
Sulfates*	--	12
Chlorides*	167	18
Iron*	2.0	0.05
Magnesium*	--	1
Calcium*	--	5
Total Hardness* (as $CaCO_3$)	13.3	15
Formation	Pliestocene Sands	Alluvial Sands

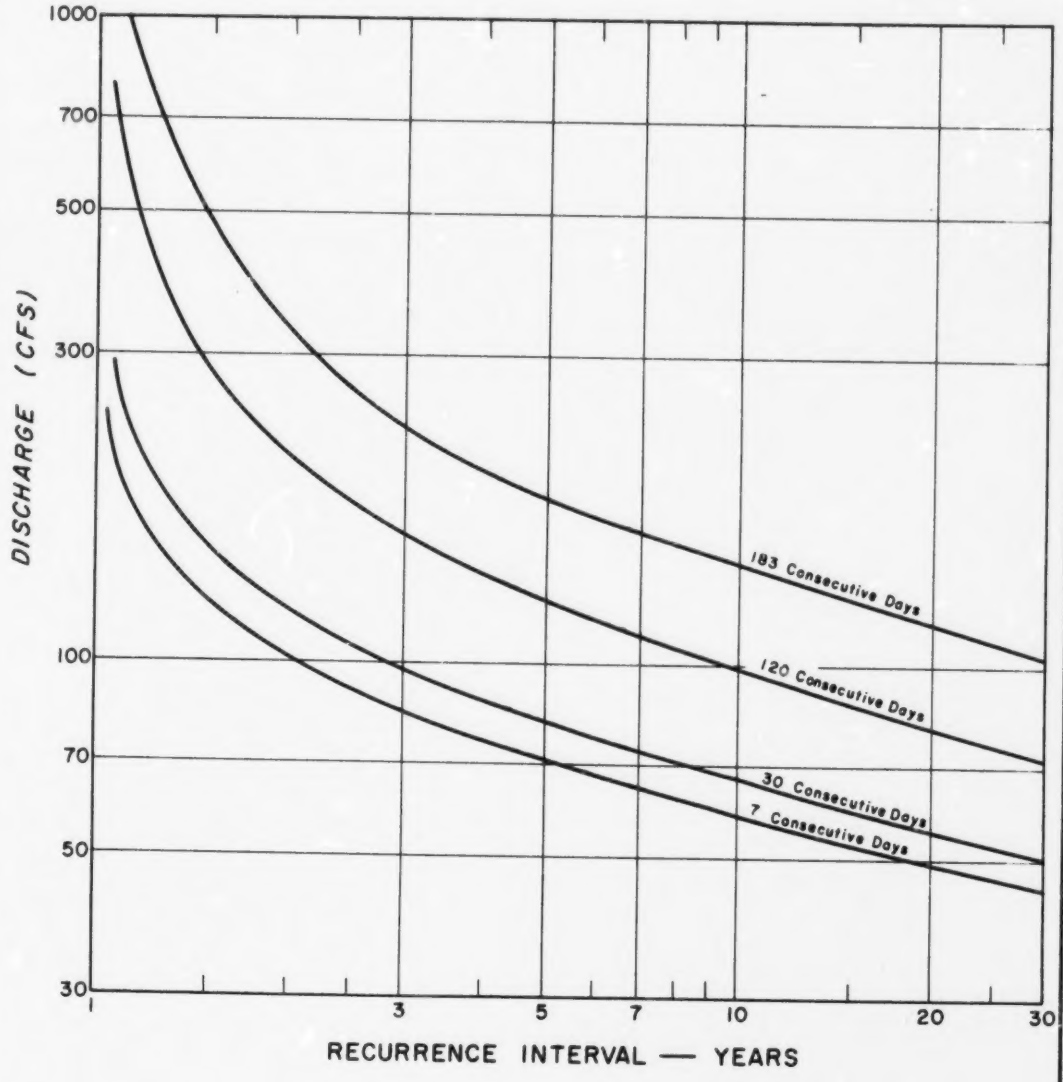
* Milligrams per liter (mg/l).

Source: Louisiana State Department of Health [3], and International Paper Company [4]

Surface Water

Bayou Bartholomew serves as the principle source of water supply for two papermills operated by International Paper Company at Bastrop, Louisiana. The paper company has constructed an off-channel storage reservoir on Bussey Brake having a capacity of 30,000 acre-feet to assure a suitable quantity of water of satisfactory quality during times of low flow in Bayou Bartholomew. Low Flow frequency curves were constructed from available data, as shown in Figure V-1.

Bayou Bartholomew is of excellent quality in all respects except color, as shown in Tables V-2 and V-3.



WATER RESOURCES STUDY
BAYOU BARTHOLOMEW–ARKANSAS & LOUISIANA

LOW-FLOW FREQUENCY CURVES

U.S. DEPARTMENT OF HEALTH, EDUCATION, & WELFARE
PUBLIC HEALTH SERVICE
REGION VII DALLAS, TEXAS

FIGURE V-1

Table V-2

Water Quality - Bayou Bartholomew at Bastrop, Louisiana, 1958-1963
(Analyses by International Paper Company)

Date	Temp. °F	pH	Color (Units)	Dissolved Solids (mg/l)	Silica as SiO_2 (mg/l)	Bicarbonates as $CaCO_3$ (mg/l)	Sulfates as SO_4 (mg/l)	Chlorides as Cl (mg/l)	Calcium as Ca (mg/l)	Magnesium as Mg (mg/l)	Sodium as Na (mg/l)	Total Hardness as $CaCO_3$ (mg/l)	Discharge* (cfs) at Beckman	Discharge* (cfs) at Jones
					Chemical Analyses by International Paper Company									
1-1-58	48	6.7	120	71	6	10	9	2	4	2	14	21	4,132	
2-4-58	45	6.5	120	75	6	8	14	2	3	2	7	16	3,010	
3-3-58	51	6.7	160	82	4	6	17	2	3	1	17	12	2,788	
4-21-58	64	7.0	160	109	3	18	7	2	5	2	0	22	3,722	
5-26-58	75	6.3	120	57	3	14	6	0	4	2	7	17	10,490	
6-16-58	82	6.4	120	60	4	16	8	2	5	2	9	21	6,915	
7-15-58	80	6.6	120	65	6	14	7	2	4	1	8	15	2,804	
8-18-58	80	6.8	110	120	15	42	8	7	14	5	12	55	[illegible]9	
9-15-58	74	6.4	120	61	5	10	6	4	3	2	8	14	3,625	
10-16-58	68	6.6	100	54	5	14	6	18	4	2	7	19	4,767	
11-18-58	65	7.1	120	156	18	60	7	11	18	6	15	68	904	
12-16-58	42	6.9	120	84	11	20	13	4	6	2	9	26	1,330	
1-19-59	46	7.1	140	140	12	44	14	7	12	4	14	44	931	
2-18-59	56	6.6	200	112	6	8	10	2	3	1	6	10	3,840	
3-16-59	57	6.4	160	89	5	10	12	4	3	1	11	12	4,323	
4-15-59	61	6.6	160	88	4	18	21	4	5	2	6	24	2,524	
5-15-59	74	6.7	160	117	7	30	9	4	8	3	10	32	1,390	
6-15-59	77	6.7	120	120	14	54	8	7	12	4	12	46	524	
7-20-59	83	7.4	100	162	18	72	8	11	18	5	16	65	523	
8-17-59	83	7.1	100	150	18	78	12	11	18	3	20	58	361	
9-21-59	76	7.1	50	175	16	100	9	18	22	8	23	87	332	
10-19-59	64	6.8	30	163	16	104	10	14	24	7	14	89		240
11-18-59	49	6.7	85	149	22	90	8	11	21	6	10	77		200
12-17-59	56	6.9	240	216	16	78	19	11	18	4	27	65		320
1-19-60	46	6.7	200	123	9	18	14	4	5	1	7	19		1,150
2-17-60	46	6.6	160	102	7	12	13	4	4	2	6	19		1,720
3-15-60	44	6.7	200	98	5	10	12	4	3	2	6	17		3,180
4-20-60	68	6.7	120	93	6	20	9	4	5	3	9	27		1,750
5-16-60	69	6.6	140	83	9	28	12	11	6	3	7	29		700
6-20-60	83	7.1	100	138	13	54	12	11	13	5	0	53		409
7-19-60	85	7.1	40	126	18	92	14	11	22	7	11	86		206
8-16-60	79	6.6	140	129	11	42	5	4	11	3	11	41		159
9-2-60	79	6.8	140	156	14	64	4	11	16	5	9	60		169
10-11-60	72	7.4	120	165	17	94	8	18	23	7	25	87		188
11-3-60	61	6.6	70	139	18	94	6	18	23	8	20	89		204
12-30-60	44	6.6	140	113	8	20	9	7	6	2	29	26		636
1-13-61	44	7.3	100	103	8	16	17	11	3	2	17	17		1,700
2-13-61	50	6.7	140	129	12	24	14	11	7	3	13	31		1,470
3-13-61	60	6.8	140	98	10	10	8	4	3	2	8	15		6,290
4-11-61	62	6.3	120	104	6	14	5	2	4	2	9	17		5,800
5-11-61	70	6.7	160	77	5	18	11	2	5	2	8	22		1,940
7-17-61	78	7.3	160	239	20	60	8	14	14	5	35	55		484
8-21-61	80	6.9	140	123	8	40	18	7	10	4	9	39		486
9-18-61	71	7.2	70	147	16	76	7	17	19	6	--	72		254
10-13-61	73	7.5	70	164	12	80	10	14	18	6	--	68		260
11-13-61	57	7.1	120	151	16	67	17	14	16	5	10	58		924
12-19-61	48	6.4	120	74	10	10	29	4	4	1	5	15		4,078
1-17-62	39	5.9	120	83	11	11	--	11	3	1	5	12		5,073
2-19-62	54	6.3	130	107	6	12	15	4	4	2	14	19		3,811
3-22-62	57	6.8	200	132	5	10	13	4	4	1	12	14		2,264
4-30-62	73	6.5	160	101	5	14	12	4	5	1	19	17		1,721
6-7-62	78	6.9	120	162	12	52	12	7	12	6	8	53		631
7-18-62	85	7.3	120	132	14	66	12	11	15	4	21	55		316
8-20-62	84	7.5	40	168	20	106	7	28	25	7	29	92		143
9-17-62	81	7.5	60	218	20	118	7	18	26	7	25	96		185
10-25-62	66	7.6	60	197	16	112	6	25	25	5	32	85		
11-22-62	55	7.4	60	177	16	88	7	14	21	7	17	80		
1-14-63	42	7.2	70	165	18	80	6	7	22	6	17	79		
2-25-63	50	7.2	80	162	8	80	16	14	15	5	9	58		
3-27-63	63	6.6	250	176	7	36	13	14	8	3	21	34		
4-22-63	76	6.4	200	149	9	44	10	14	8	3	30	34		
5-29-63	77	6.7	180	193	11	44	14	7	10	4	40	42		
7-8-63	86	6.9	80	153	8	76	5	7	14	5	28	58		
8-14-63	84	6.3	200	146	9	33	10	11	7	3	22	31		

* U.S. Geological Survey

Table V-3

Water Quality - Bayou Bartholomew at Bastrop, Louisiana, 1958-1963
(Analyses by Louisiana Stream Control Commission)

Date	pH	Temp. °F	Dissolved Oxygen (mg/l)	Total Alkalinity as $CaCO_3$ (mg/l)	Total Hardness as $CaCO_3$ (mg/l)	Turbidity (Units)	Spec. Cond. (micromhos/cm² at 25°C	Color (Units)	Chlorides as Cl (mg/l)	Sodium as Na (mg/l)	Potassium (mg/l)
Chemical Analyses by Louisiana Stream Control Commission Laboratory (Near Bastrop)											
June 1-15, 1958	---	77.9	2.6	32.0	18.0	< 30	108.0	65.0	9.9	11.0	---
June 16-30, 1958	---	79.7	2.8	29.4	25.2	< 30	77.5	55.0	5.0	3.0	---
July 1-15, 1958	---	77	4.0	32.4	22.0	30	77.5	35.0	5.0	---	---
July 16-31, 1958	---	79.7	4.0	30.0	22.8	30	---	25.0	7.18	5.0	3.0
Aug. 1-15, 1958	7.4	82.4	4.6	51.0	42.8	< 30	146.1	10.0	8.75	10.0	4.0
Aug. 16-31, 1958	7.2	78.8	5.4	73.6	56.8	< 31	189.1	20.0	11.3	---	---
Sept. 1-15, 1958	6.6	78.8	5.6	70.0	58.0	< 45	---	26.0	5.0	10.0	9.0
Sept. 16-30, 1958	6.4	77	4.5	26.0	23.0	< 29	---	40.0	2.15	4.5	4 6
Oct. 1-15, 1958	6.8	68	4.4	20.0	180.0	< 30	---	65.0	1.3	4.5	4.0
Oct. 16-31, 1958	6.5	71.6	6.1	22.0	30.0	< 30	---	40.0	2.5	8.0	6 0
Nov. 1-15, 1958	6.6	64.4	7.3	28.0	27.2	< 30	134.0	35.0	12.9	9.5	8.0
Nov. 16-30, 1958	7.0	71.6	6.4	58.0	46.0	< 30	287.0	25.0	12 0	19.0	5.0
Dec. 1-15, 1958	6.7	57.2	9.2	24.0	24.4	< 30	129.0	60.0	5.0	23 0	6.0
Dec. 16-31, 1958	6.7	42.8	11.0	26.0	28.0	< 30	143.0	60.0	6.0	30 0	8.5
Jan. 1959	7.3	44.7	11.1	54	56.6	30	235.5	20	12	36	6.75
Feb. 1959	6.8	50.9	9.25	18	21	41	128	42.5	10.2	38	8
Mar. 1959	6.6	54.5	8.3	16	32.8	30	64.5	45	6	27.2	7.3
Apr. 1959	6.8	63.5	6.7	24	24.6	33.5	173.5	33.5	5.5	31.5	8
May 1959	6.5	75.2	6.6	21	20.4	30	80	30	4.5	31	8
June 1959	7.5	77	6.6	70	70.4	30	207	10	11.1	26	10
July 1959	7.2	82.4	6.6	66	66	88	220	20	12.8	26	8.5
Aug. 1959	7.8	86	5.9	58	54.8	30	213	30	19.2	20	4.3
Sept. 1959	7.4	82.4	6.4	94	84.8	30	188	20	16.3	23	4.1
Oct. 1959	8.3	78.8	6.9	114	94.4	30	201	25	19	34	7
Nov. 1959	7.6	66.2	7.8	86	82	30	234	20	15.8	25	8.3
Dec. 1959	7.6	48.2	10.6	---	97.2	30	264	20	15.4	21	6.5
Jan. 1960	7.0	48.2	11.0	52	54.4	< 30	171	20	10.8	14	6.1
Feb. 1960	6.8	46.4	10.4	19	29.6	45	83	60	6.2	12	5.5
Mar. 1960	6.6	41	10.6	13	22	35	73	50	5.1	20	5.4
Apr. 1960	6.6	64.4	8.2	14	19.6	< 30	68	40	10.2	13	7.5
May 1960	7.5	69.8	6.4	36	38.8	< 30	136	35	6.4	20	4.0
June 1960	7.1	80.6	5.6	57.0	56.4	< 30	210	20	17.6	17	3.5
July 1960	7.5	84.2	5.4	76	72	< 30	226	20	16.8	25	3.3
Aug. 1960	7.8	84.2	6.0	82	79.6	< 30	245	30	17.36	20	3.9
Sept. 1960	7.4	84.2	5.2	60	62.8	< 30	200	30	11.9	27	4.5
Oct. 1960	7.5	75.2	7.0	92	86.8	< 30	287.9	10	17.1	24	3.2
Nov. 1960	8.4	62.6	9.2	83	89.6	< 30	281	10	17.8	23	4.0
Dec. 1960	7.5	57.2	9.8	58	66.0	30	247	30	14.4	17	4.7
Jan. 1961	7.3	42.8	10.6	16	32	< 35	120	50	6.2	5.5	3.7
Feb. 1961	7.4	44.6	11.4	29	32.8	50	176	30	16.1	15	4.0
Mar. 1961	7.3	55.4	8.4	20	13.2	< 30	63.9	55	3.4	2	3.1
Apr. 1961	8.3	62.6	---	28	21.2	< 30	63.2	60	3.75	1.0	3.0
May 1961	7.4	71.6	5.6	28	26.8	< 30	120	60	7.04	4.0	6.8
June 1961	7.2	78.8	6.2	26.8	23	35	141.2	25	5.6	3	3.2
July 1961	7.2	82.4	6.6	56.0	55.6	< 25	173.8	30	10	12	3.1
Aug. 1961	7.2	84.2	6.0	46	45.2	39	166.39	35	8.36	11	3.6
Sept. 1961	7.6	86	6.4	64	62.8	40	182	30	10.9	12.5	3.5
Oct. 1961	7.8	73.4	7.6	78	79.2	< 30	244	20	11	20	3.0
Nov. 1961	7.7	33.8	7.6	4	7.6	30	223	10	16	19	3.4
Dec. 1961	7.2	55.4	8.0	20.2	24.8	< 30	70.6	60	10	4	3.6
Jan. 1962	6.6	46.4	9.8	12	18.8	35	57.4	45	4.3	1	1.9
Feb. 1962	6.6	51.8	9.4	12	15	< 30	47.8	30	3.3	1	2.5
Mar. 1962	7.3	50	8.4	33	18	28	115.2	30	6	2	3.7
Apr. 1962	7.0	59	8.0	17	17	28	72	25	5	9	2.5
May 1962	7.0	70.7	5.8	26	26	29	82.4	40	4.8	7	2.7
June 1962	7.1	76.1	5.8	57	51	34	160	20	9.4	12	3.1
July 1962	7.1	83.3	5.6	62	55	58	212	50	22	11	3.6
Aug. 1962	7.2	89.6	7.2	99	84	42	338	30	27	23.5	5.5
Sept. 1962	7.5	86	4.6	112	97	< 30	279	20	29.5	22.5	2.7
Oct. 1962	7.5	80.6	4.2	94	97	45	385	25	57	20	3.5
Nov. 1962	7.9	59	5.6	90	88	< 30	233.2	15	15.2	17.5	3.0
Dec. 1962	---	---	---	---	---	---	---	---	---	---	---
Jan. 1963	---	---	---	---	---	---	---	---	---	---	---
Feb. 1963	7.5	50	13	78	86	30	385	20	23.6	24	3.0
Mar. 1963	7.7	53.6	9.0	49	53	50	325	30	15.5	19	3.5
Apr. 1963	6.9	73.4	8.1	32	40	63	179	60	9 5	9.0	2.0
May 1963	6.9	75.2	6.8	32	53	82	309	45	13	11	3.5
June 1963	8.0	77	7.8	63	68	< 35	235	40	12.5	19.0	2.2
July 1963	7.7	91.4	7.2	68	68	< 30	311	29	17	17	2.9
Aug. 1963	7.2	80.6	6.6	36	37	73	212	55	8.5	10	3.0
Sept. 1963	7.5	80.6	7.2	86	80	32	367	20	20.5	306	4.5
Oct. 1963	7.8	78.8	7.4	104	103	< 30	621	25	35	24	3.0
Nov. 1963	8.0	53.6	7.9	105	104	30	414	25	27.5	30	2.5
Dec. 1963	7.2	59	8.0	98	92	55	335	25	24	26	2.5

VI. WATER USE

International Paper Company's two mills at Bastrop, Louisiana have a combined capacity of 1,315 tons of paper daily. This output requires 47.5 mgd for operation, of which 26 mgd is obtained from Bayou Bartholomew and 21.5 mgd from wells.

The major portion of the larger papermill's water supply is clarified in coagulation and sedimentation units. Roughly 10 percent of the total use is further treated by demineralization.

The paper company produces a fine quality of punch card stock requiring a high quality of process water. Most of the water used in this process is obtained from Bayou Bartholomew. The cost of preparation of this water for use in the paper making process is a function of raw (untreated) water quality. Raw water quality requirements for this process are shown in Table VI-1.

Table VI-1

Raw Water Quality Specifications
Louisiana Mill, International Paper Company
Bastrop, Louisiana

	Necessary Quality	Maximum Short Term Allowable
pH	6.8	7.6
Color	125	250
Total Solids, mg/l	125	240
Silica, as SiO_2, mg/l	11	22
Bicarbonate Alkalinity (as $CaCO_3$), mg/l	45	120
Sulfates, as SO_4, mg/l	10	30
Chlorides, as Cl, mg/l	9	28
Calcium, as Ca, mg/l	12	26
Magnesium, as Mg, mg/l	4	8
Sodium, as Na, mg/l	14	40
Total Hardness, as $CaCO_3$, mg/l	45	96

Note: Iron content of raw water must not exceed a level treatable to less than 0.1 mg/l and manganese content treatable to less than 0.05 mg/l.

Source: International Paper Company 5/

In addition to serving as a source of industrial water supply, Bayou Bartholomew is reputed to be one of the best fishing streams in northern Louisiana.

VII. STUDY METHODS AND FINDINGS

This study was concerned with estimation of effects of flood control works on water quality. Indications are that physical and chemical water quality in Bayou Bartholomew varies with streamflow. Therefore, the study was directed toward effects of flood control works on quantity of flow as well.

Evaluation of the effects of channel modification on water quality have been based upon water quality analyses before and after similar channel modification on Bayou LaFourche and Bayou Macon, which adjoin Bayou Bartholomew on the east.

Runoff Patterns

As shown in Figures VII-1 and VII-2, rainfall and runoff patterns for all three basins are similar. All three are located on the ancient alluvial plain which borders the west side of the Mississippi River.

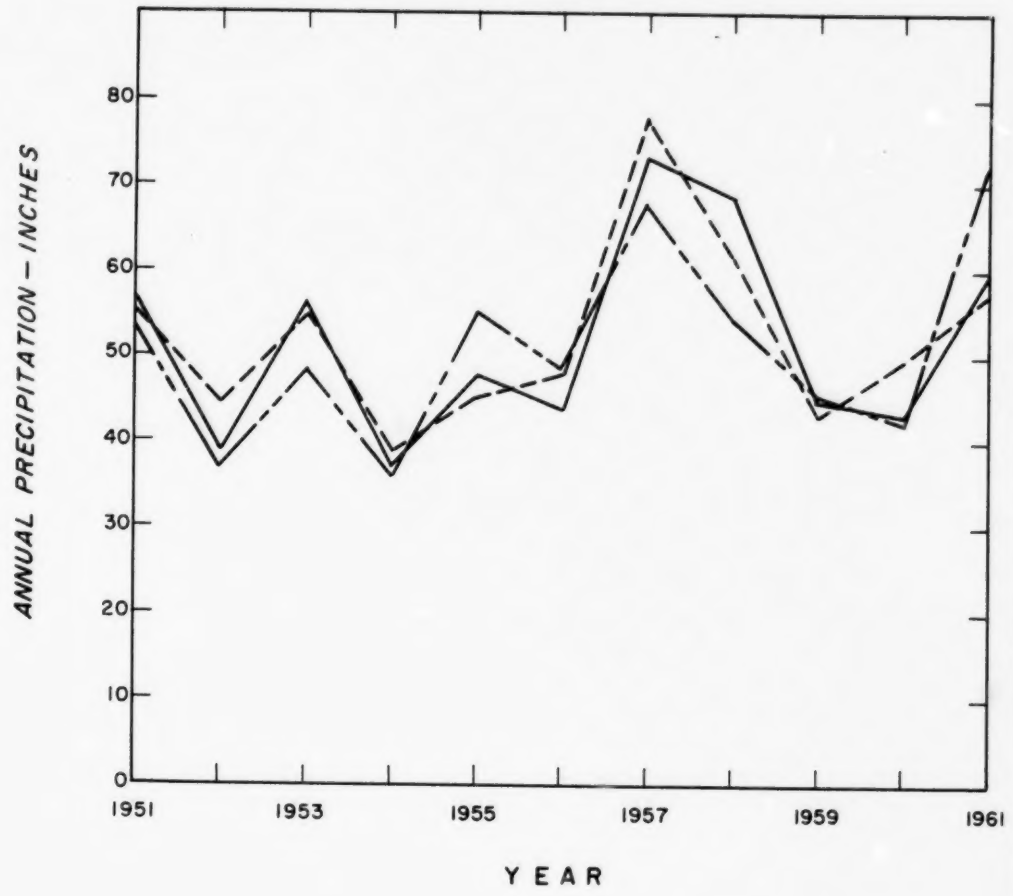
Normally, the major streams in the area are effluent and receive much of their base flow from the alluvial aquifer. As the stream stages rise during the rainy season, the ground water gradients near the streams are lessened and sometimes reversed, and the streams become influent and recharge the aquifer. The extent and duration of this effect depend on the duration of the high stage of the stream. 6/

Bayou LaFourche

Bayou LaFourche, a tributary to Boeuf River, had its channel modified in 1952. Low flows in this stream were compared for similar conditions. The year 1954 (following the channel modifications) had an average annual flow which will be equalled or exceeded 83 percent of the time, while 1941 (preceding the modifications), had a nearly equal flow. The flow patterns for these two years are shown on Figure VII-3.

Bayou Macon

Channel modifications were undertaken on Bayou Macon in May 1962. This work extended upstream from Delhi, Louisiana for about 50 miles and required approximately 18 months for completion. The city of Delhi obtains its raw water from Bayou Macon near the start of the channel modifications.



LEGEND

——— DUMAS, ARKANSAS

– – – – PINE BLUFF, ARKANSAS

——– – – MONROE, LOUISIANA

WATER RESOURCES STUDY

BAYOU BARTHOLOMEW–ARKANSAS & LOUISIANA

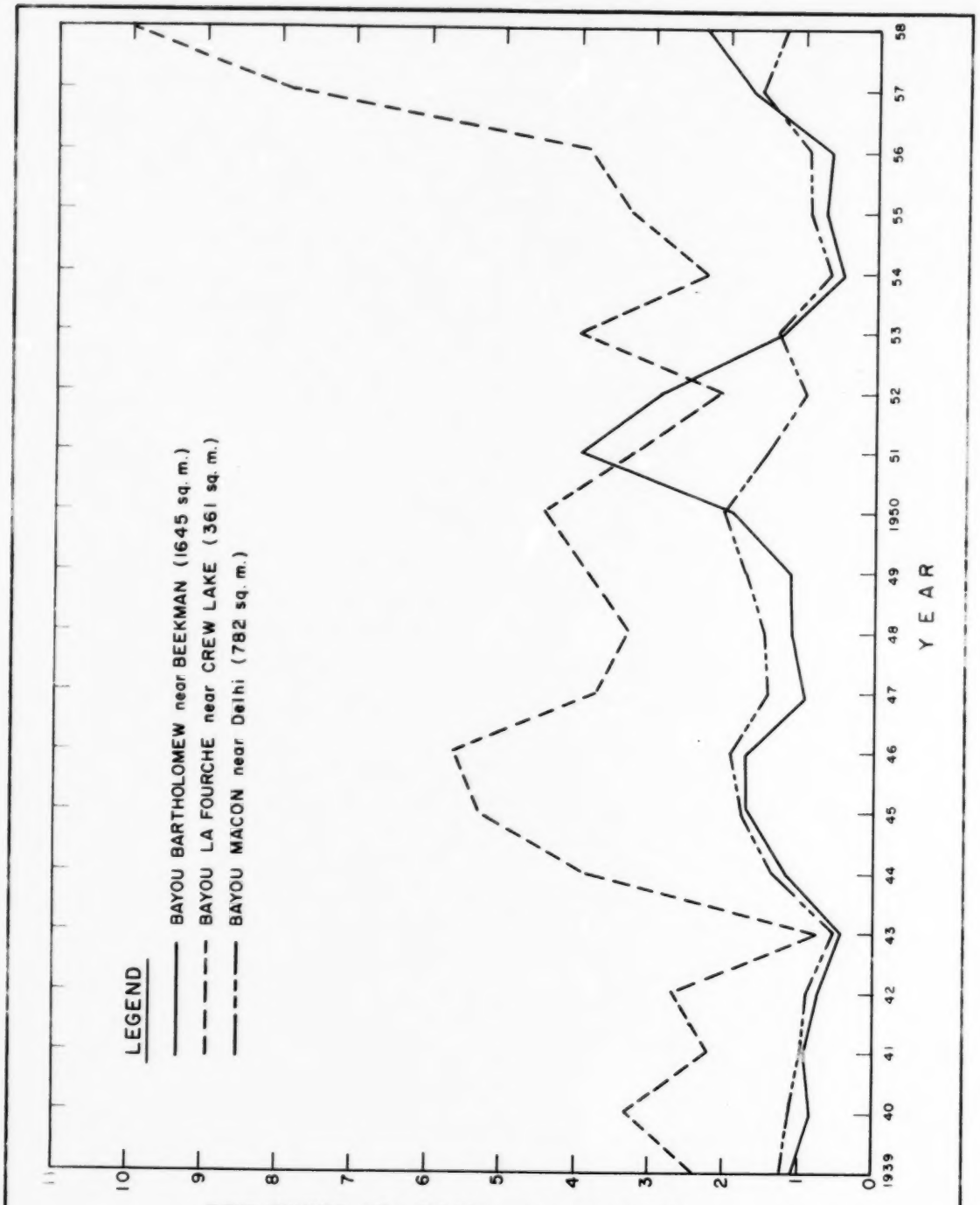
BASIN PRECIPITATION

U.S. DEPARTMENT OF HEALTH, EDUCATION, & WELFARE

PUBLIC HEALTH SERVICE

REGION VII DALLAS, TEXAS

FIGURE VII-1

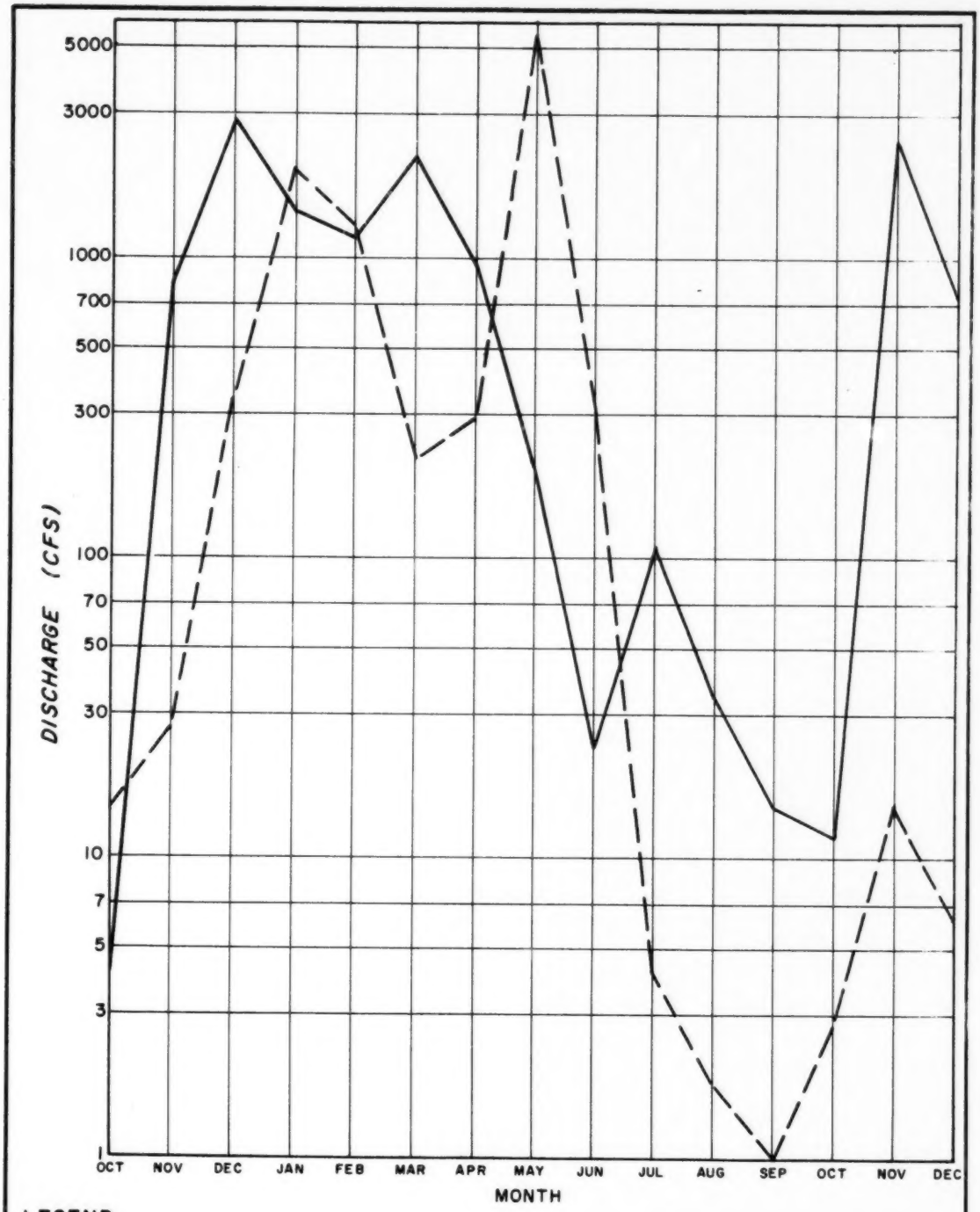


WATER RESOURCES STUDY
BAYOU BARTHOLOMEW–ARKANSAS & LOUISIANA

MEAN ANNUAL STREAMFLOW

U.S. DEPARTMENT OF HEALTH, EDUCATION, & WELFARE
PUBLIC HEALTH SERVICE
REGION VII DALLAS, TEXAS

FIGURE VII-2



LEGEND

——— WATER YEAR 1941 BEFORE CHANNEL MODIFICATION

– – – – WATER YEAR 1954 AFTER CHANNEL MODIFICATION

WATER RESOURCES STUDY
BAYOU BARTHOLOMEW—ARKANSAS & LOUISIANA

BAYOU LA FOURCHE FLOW PATTERN

U.S. DEPARTMENT OF HEALTH, EDUCATION, & WELFARE
PUBLIC HEALTH SERVICE
REGION VII DALLAS, TEXAS

FIGURE VII-3

The city's water treatment consists of coagulation, sedimentation, and chlorination. Water use averages between 0.2 to 0.3 mgd.

Only a few water quality analyses are run on a daily, routine basis at the water plant. These include turbidity, hardness, alkalinity, pH, and chlorine residual. Records are also kept on the amount of alum, lime, and chlorine used, as well as raw water pumpage.

The Louisiana Stream Control Commission has collected samples of Bayou Macon at Delhi, Louisiana on a routine basis since 1958. The tabulation of these analyses is shown in Table VII-1. Water treatment trends at Delhi with respect to turbidity are graphically presented in Figure VII-4.

Discussion

The results of analyses of the paper company and the Stream Control Commission both indicate a relatively high color in Bayou Bartholomew. Indications are that the paper company's water treatment facility is capable of reducing the color to a concentration suitable for processing wood pulp to process a fine grade of punch card stock and other high quality papers.

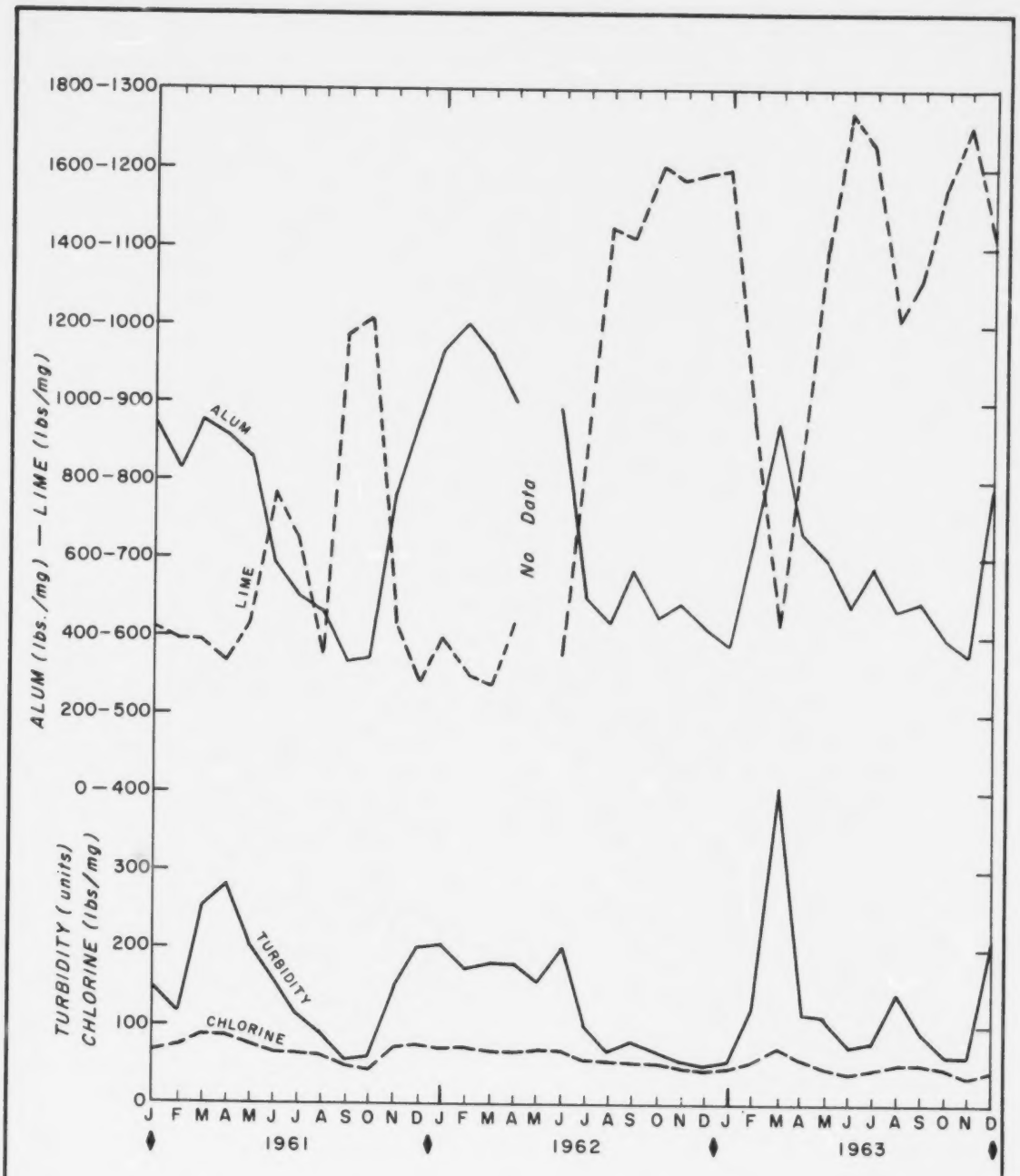
The effect of ground water seepage from the alluvial aquifer on water quality in Bayou Bartholomew is not clearly defined. Additional study of this aspect would be valuable should additional evaluation be required.

Available data indicate that channel modifications will increase turbidity during the time the modification is being carried out. Based upon the effect on Bayou LaFourche, dry weather flow would be reduced by channel modification. Since channel modification will result in increased turbidity, expectations are that the habitat for fish and other aquatic biology will be damaged.

Table VII-1

Water Quality - Bayou Macon near Delhi, Louisiana, 1958-1963
(Analyses by Louisiana Stream Control Commission)

Date	pH	Temp. °F	Dissolved Oxygen (mg/l)	Total Alkalinity as $CaCO_3$ (mg/l)	Total Hardness as $CaCO_3$ (mg/l)	Turbidity (Units)	Spec. Cond. (μmhos/cm_3) at 25°C	Color (Units)	Chlorides as Cl (mg/l)	Sodium as Na (mg/l)	Potassium (mg/l)
Chemical Analyses by Louisiana Stream Control Commission Laboratory (Near Delhi)											
June 1-15, 1958	--	77.0	2.6	58.0	92.0	< 30	132.0	45.0	5.0	8.0	--
June 16-30, 1958	--	82.4	3.2	64.0	61.6	28	137.9	30.0	5.62	--	2.0
July 1-15, 1958	--	79.7	4.2	85.0	71.6	38	194.8	20.0	8.12	--	--
July 16-31, 1958	--	83.8	4.2	76.0	69.2	30	194.8	30.0	9.37	5.9	3.5
Aug. 1-15, 1958	7.6	86.9	4.0	113.0	98.4	< 31	279.6	20.0	12.5	13.0	5.0
Aug. 16-31, 1958	8.0	81.5	4.4	134.0	129.0	57	338.4	20.0	17.5	--	0
Sept. 1-15, 1958	7.2	77.0	4.6	160.0	152.0	< 65	--	20.0	14.0	17.0	6.0
Sept. 16-30, 1958	7.0	80.6	4.5	92.0	89.0	< 32	--	30.0	6.3	11.5	7.0
Oct. 1-15, 1958	7.5	71.6	2.9	50.0	52.8	< 30	--	50.0	3.8	7.1	6.3
Oct. 16-31, 1958	7.2	73.4	5.8	76.0	70.0	30	--	30.0	6.3	11.5	8.0
Nov. 1-15, 1958	7.0	64.4	6.4	90.0	109.0	30	415.0	39.0	10.1	20.0	9.5
Nov. 16-30, 1958	7.8	66.2	6.8	133.0	162.0	< 30	514.0	20.0	16.0	26.0	7.0
Dec. 1-15, 1958	7.3	57.2	9.2	80.0	97.0	< 30	429.0	40.0	10.0	30.0	8.0
Dec. 16-31, 1958	7.1	42.8	11.1	88.0	124.0	< 30	429.0	30.0	13.0	44.0	9.5
Jan. 1959	7.7	49.1	10.8	137.0	154.0	52.5	1,447.5	30.0	20.5	61.0	10.0
Feb. 1959	7.6	52.7	9.0	78.0	90.4	121	361.5	40.0	18.5	40.0	9.5
Mar. 1959	7.1	58.1	8.2	66.0	78.4	110	268.0	45.0	10.0	33.3	9.75
Apr. 1959	7.6	64.4	7.1	98.0	116.0	42.5	418.5	30.0	12.4	42.5	9.6
May 1959	7.9	75.2	5.2	112.0	110.8	65	322.0	30.0	10.5	37.0	8.9
June 1959	8.0	80.6	4.4	170.0	173.2	40	468.0	10.0	18.9	39.0	13.2
July 1959	7.6	84.2	5.4	178.0	189.8	61	485.0	20.0	30.0	36.0	9.0
Aug. 1959	7.3	86.0	3.2	95.0	110.4	85	299.0	30.0	18.1	21.0	6.8
Sept. 1959	8.2	84.2	3.4	220.0	227.2	< 32	403.0	25.0	33.5	34.0	5.7
Oct. 1959	8.6	80.6	4.8	205.0	214.4	< 30	364.0	20.0	37.8	43.0	7.2
Nov. 1959	7.9	66.2	8.3	198.0	214.0	< 30	535.0	15.0	39.7	50.0	8.3
Dec. 1959	7.7	50.0	8.4	210.0	224.0	< 30	542.0	20.0	36.5	40.0	7.5
Jan. 1960	7.4	48.2	7.8	128	143.20	90	378	30	21.6	25	8.7
Feb. 1960	7.5	50.0	9.2	84	100.0	85	240	60	16.4	21	7.4
Mar. 1960	6.9	42.8	10.0	50	60.0	210	151	50	8.7	58	6.2
Apr. 1960	7.6	59.0	8.0	78	84.0	120	225	40	11.7	16	8.8
May 1960	8.3	69.8	5.4	155	164.8	30	435	30	29.8	38	5.0
June 1960	7.9	82.4	4.4	181.0	187.6	< 30	494	20	25.5	24	5.0
July 1960	8.4	86.0	3.8	118	127.2	< 30	373	30	24.5	21	4.5
Aug. 1960	8.0	86.0	3.2	242	52.0	< 30	630	25	83.49	48	5.4
Sept. 1960	7.9	80.6	2.4	104	110.4	60	324	30	19.3	23	5.7
Oct. 1960	7.9	77.0	6.0	212	229.2	32	607.9	20	45.1	38	5.1
Nov. 1960	8.6	64.4	7.1	188	218	< 30	535	5	29.8	29	4.4
Dec. 1960	7.5	51.8	10.0	114	140.4	65	412	30	24.3	22	6.2
Jan. 1961	7.7	44.6	10.4	62	77.6	110	240	30	11.9	12.5	5.5
Feb. 1961	8.1	44.6	10.0	120	139.2	65	353	30	22.1	17	4.6
Mar. 1961	7.8	62.6	7.0	55	58.0	125	155.5	50	7.24	4	5.0
Apr. 1961	8.2	62.6	--	53	49.2	150	126.3	60	5.39	3.0	5.5
May 1961	7.8	71.6	5.9	96	104.8	140	197	45	7.50	8	5.0
June 1961	8.1	78.8	5.0	124	140.8	75	454.6	25	15.9	14	4.5
July 1961	8.1	82.4	6.2	135.0	149	< 25	396.3	20	16.0	21	3.5
Aug. 1961	7.7	86.0	4.6	13	27.6	41	352.95	25	15.75	16	4.0
Sept. 1961	7.9	86.0	4.4	171	179.6	< 30	438	30	20.6	26.5	4.0
Oct. 1961	8.3	71.6	8.0	176	196.8	< 30	516	20	28.4	29	4.5
Nov. 1961	7.5	64.4	6.4	113	124.4	130	355	30	21	18	6.0
Dec. 1961	7.9	55.4	7.4	108.2	124.0	< 35	296.5	20	17.5	17	5.0
Jan. 1962	7.2	46.4	8.4	54	65.2	140	147.3	40	8.0	4.5	4.6
Feb. 1962	7.0	48.2	9.8	58	60	150	148.6	30	7.0	6	5.5
Mar. 1962	7.5	51.8	8.6	94	104	100	217.2	45	5.5	8	4.2
Apr. 1962	7.7	59.0	7.4	114	128	100	299	20	12.5	15	3.6
May 1962	7.5	77.0	5.4	94	107	125	267.1	30	11.8	12.5	4.6
June 1962	7.2	77.0	4.0	94	108	250	267	30	12.3	13	5.0
July 1962	7.9	89.6	7.6	176	183	50	446	30	29.0	25	4.5
Aug. 1962	--	--	--	--	--	--	--	--	--	--	--
Sept. 1962	7.9	86.0	4.6	211	220	< 30	471	20	42	26	4.6
Oct. 1962	6.7	78.8	5.0	22	68	< 30	529	60	214	66	2.5
Nov. 1962	7.0	59.0	6.0	21	52	60	343.9	20	81.8	43	2.0
Dec. 1962	--	--	---	--	--	--	--	--	--	--	--
Jan. 1963	--	--	--	--	--	--	--	--	--	--	--
Feb. 1963	7.7	50.0	8.4	141.0	168.0	120	459.0	25.0	25.0	21.0	4.0
Mar. 1963	7.5	51.8	8.5	116.0	126.0	190	471.0	50.0	20.8	28.0	4.0
Apr. 1963	7.5	73.4	8.5	188.0	219.0	87	497.0	25.0	32.0	30.0	2.5
May 1963	7.8	75.2	6.9	213.0	224.0	63	691.0	35.0	39.5	31.0	3.0
June 1963	8.4	77.0	7.1	220.0	248.0	< 30	743.0	10.0	52.5	45.0	3.0
July 1963	8.7	91.4	6.9	204.0	223.0	< 30	605.0	30.0	35.0	29.0	3.5
Aug. 1963	7.8	82.4	6.7	116.0	116.0	131	410.0	55.0	46.5	19.0	4.0
Sept. 1963	8.3	80.6	6.9	198.0	211.0	35	766.0	25.0	47.0	106.0	4.5
Oct. 1963	7.9	78.8	7.2	232	260	30	1,071	25	97.5	50	3.5
Nov. 1963	8.4	53.6	8.2	255	286	30	800	15	46.0	47	3.2
Dec. 1963	7.5	60.8	8.3	189	217	110	526	29	29.0	28	3.0



WATER RESOURCES STUDY

BAYOU BARTHOLOMEW-ARKANSAS & LOUISIANA

WATER TREATMENT AND TURBIDITY

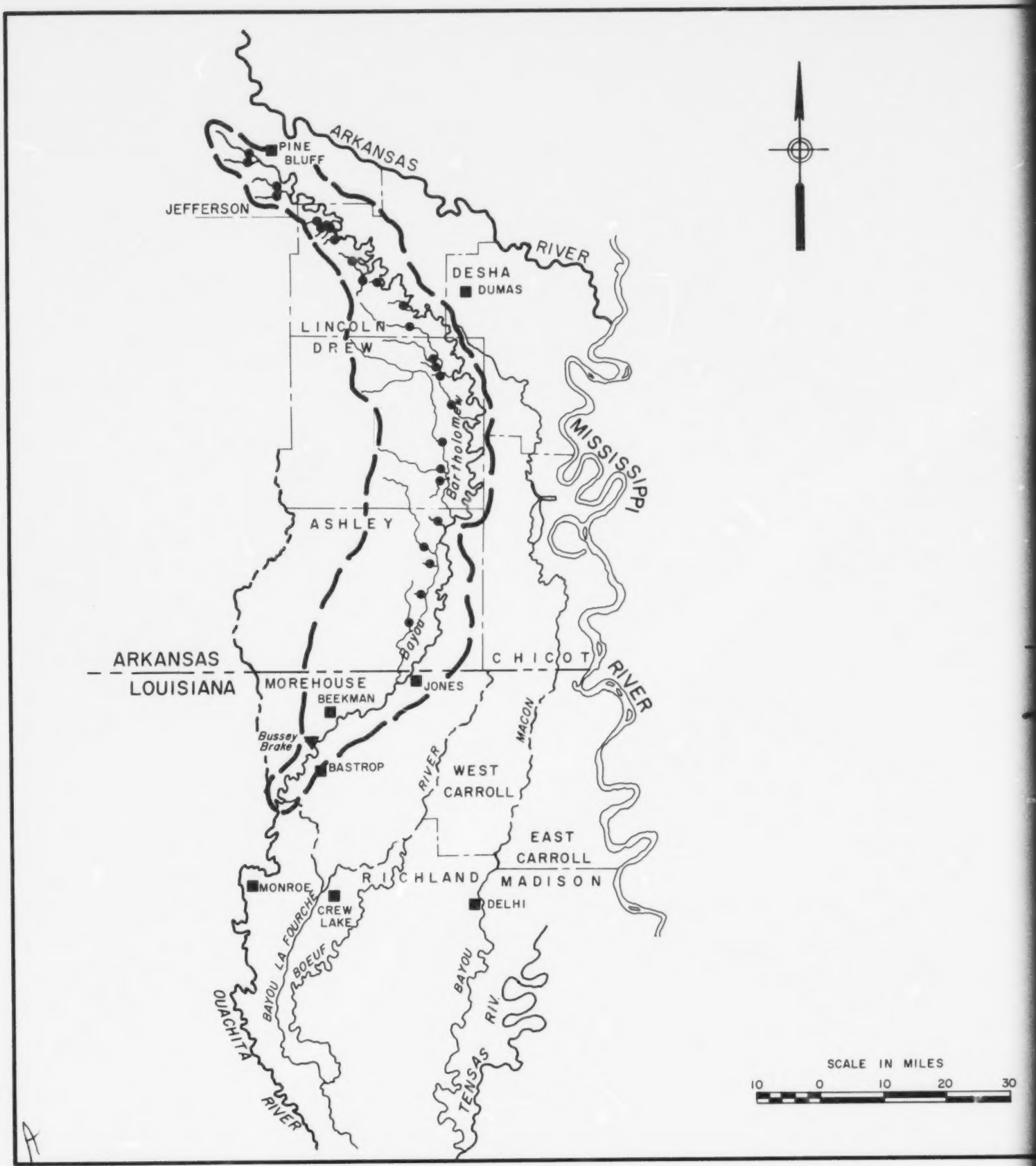
DELHI, LOUISIANA

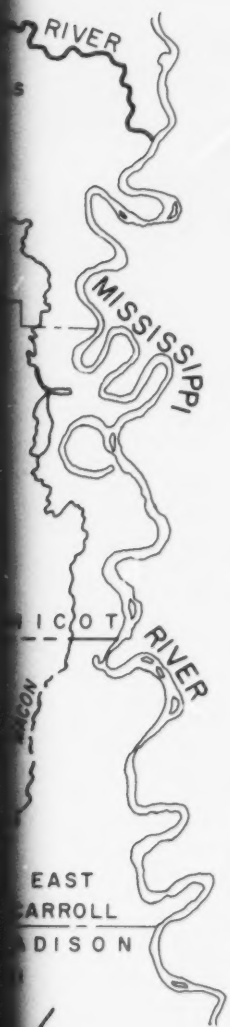
U.S. DEPARTMENT OF HEALTH, EDUCATION, & WELFARE

PUBLIC HEALTH SERVICE

REGION VII — DALLAS, TEXAS

FIGURE VII-4


ARKANSAS
PINE BLUFF
JEFFERSON
RIVER
DESHA
DUMAS
LINCOLN
DREW
Bartholomew
MISSISSIPPI
ASHLEY
Bayou
ARKANSAS
LOUISIANA
MOREHOUSE
BEEKMAN
JONES
CHICOT
RIVER
Bussey Brake
BASTROP
RIVER
MACON
WEST CARROLL
EAST CARROLL
MADISON
RICHLAND
MONROE
CREW LAKE
DELHI
BAYOU LA FOURCHE
BOEUF
BAYOU
TENSAS RIV.
OUACHITA
RIVER
SCALE IN MILES
10 0 10 20 30



LEGEND

Flood Retarding Reservoir

Basin Boundary

SCALE IN MILES

10 0 10 20 30

WATER RESOURCES STUDY

BAYOU BARTHOLOMEW – ARKANSAS & LOUISIANA

LOCATION MAP

U.S. DEPARTMENT OF HEALTH, EDUCATION, & WELFARE

PUBLIC HEALTH SERVICE

REGION VII DALLAS, TEXAS

FIGURE III-1

VIII. BIBLIOGRAPHY

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